

# Genetics, Geography, and Satellites:

## *From genes to space*



Dr. Emil A. Cherrington  
NASA SERVIR SCO / UAH ESSC

SERVIR 



**USAID**  
FROM THE AMERICAN PEOPLE



ICIMOD

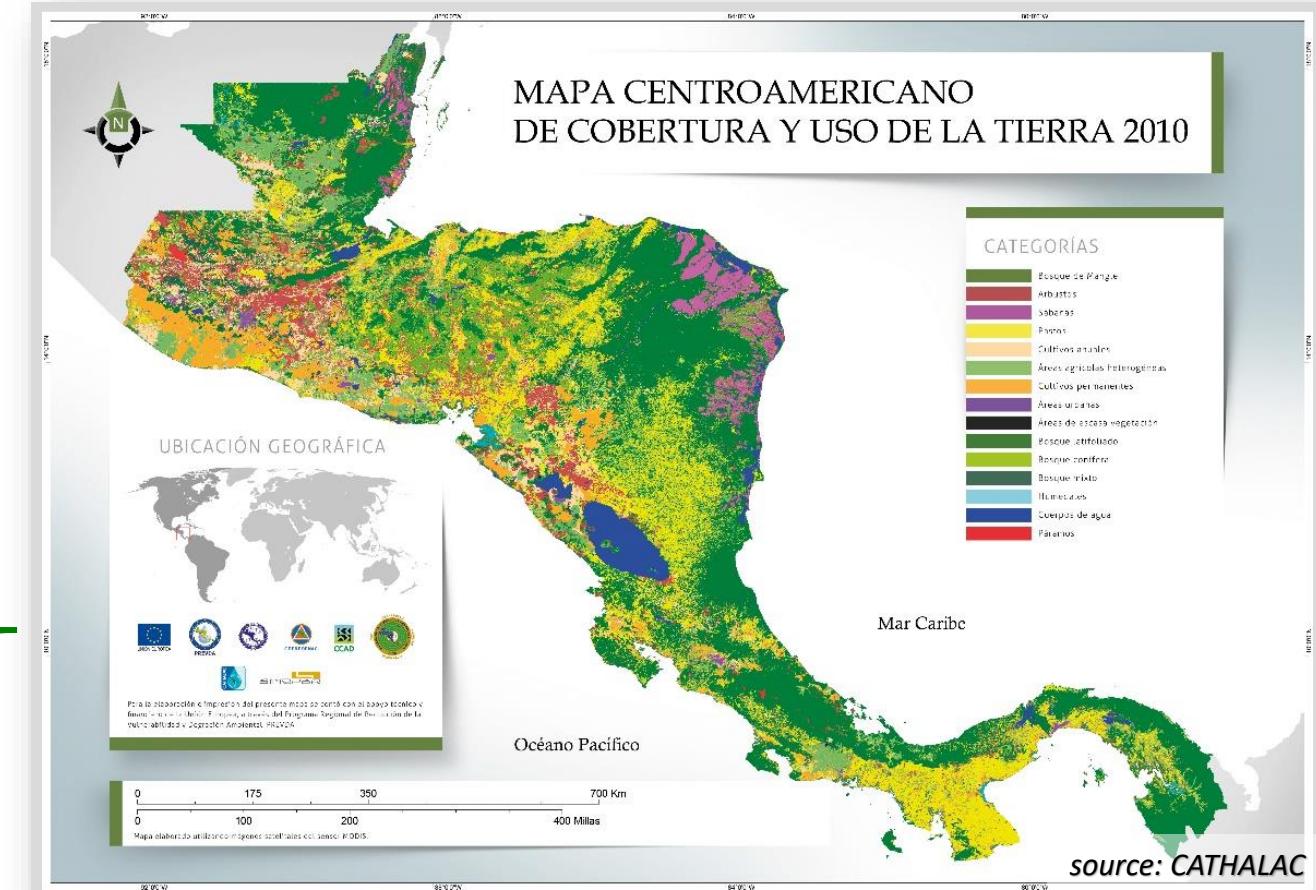
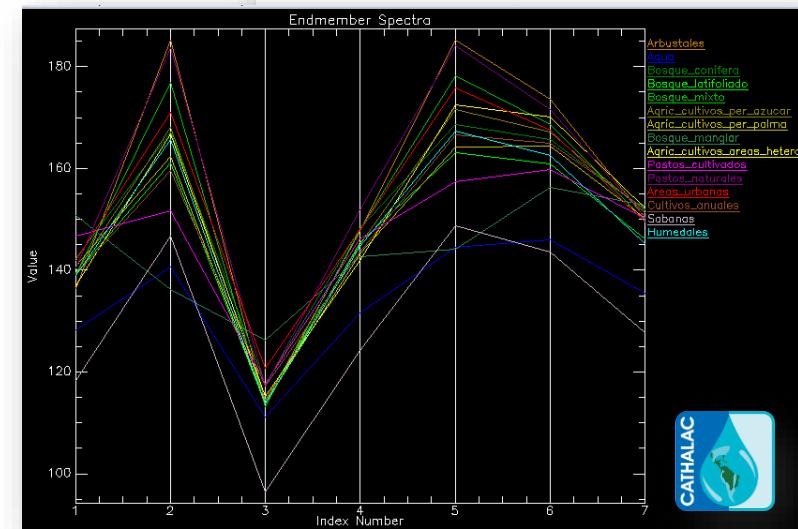
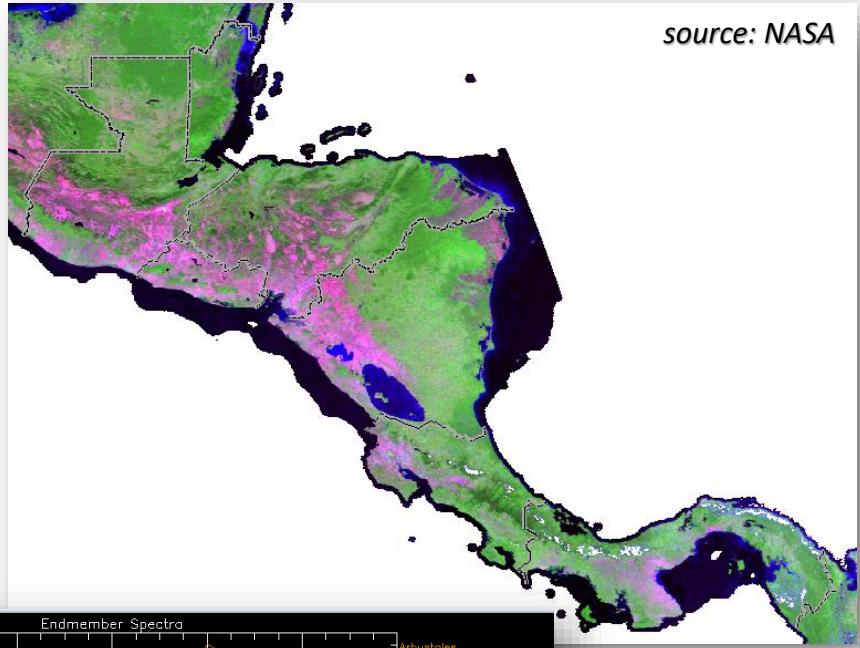
adpc



*Ignite* 11.10.17

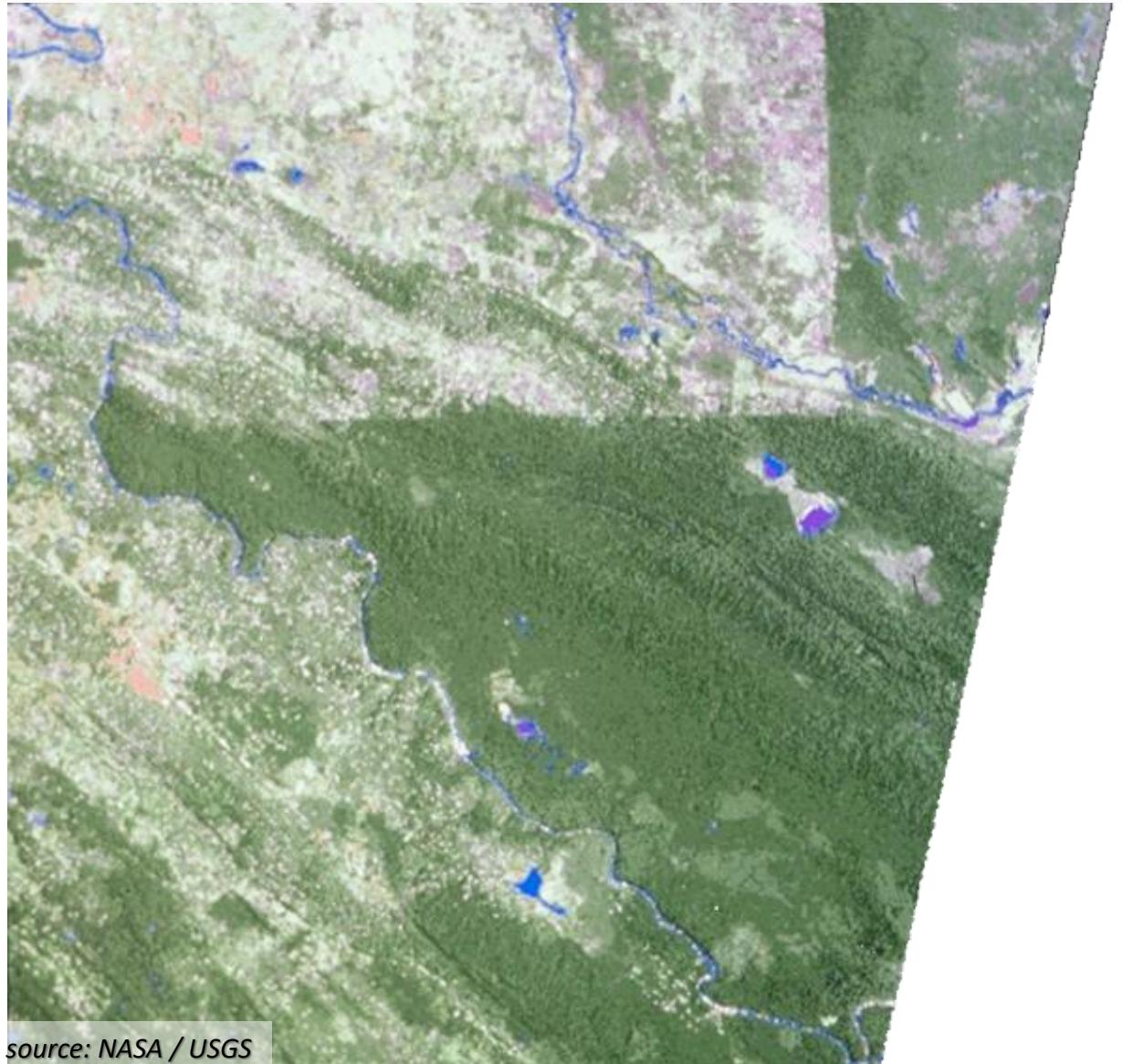
# PT1: Land cover has always been a focus of SERVIR

2

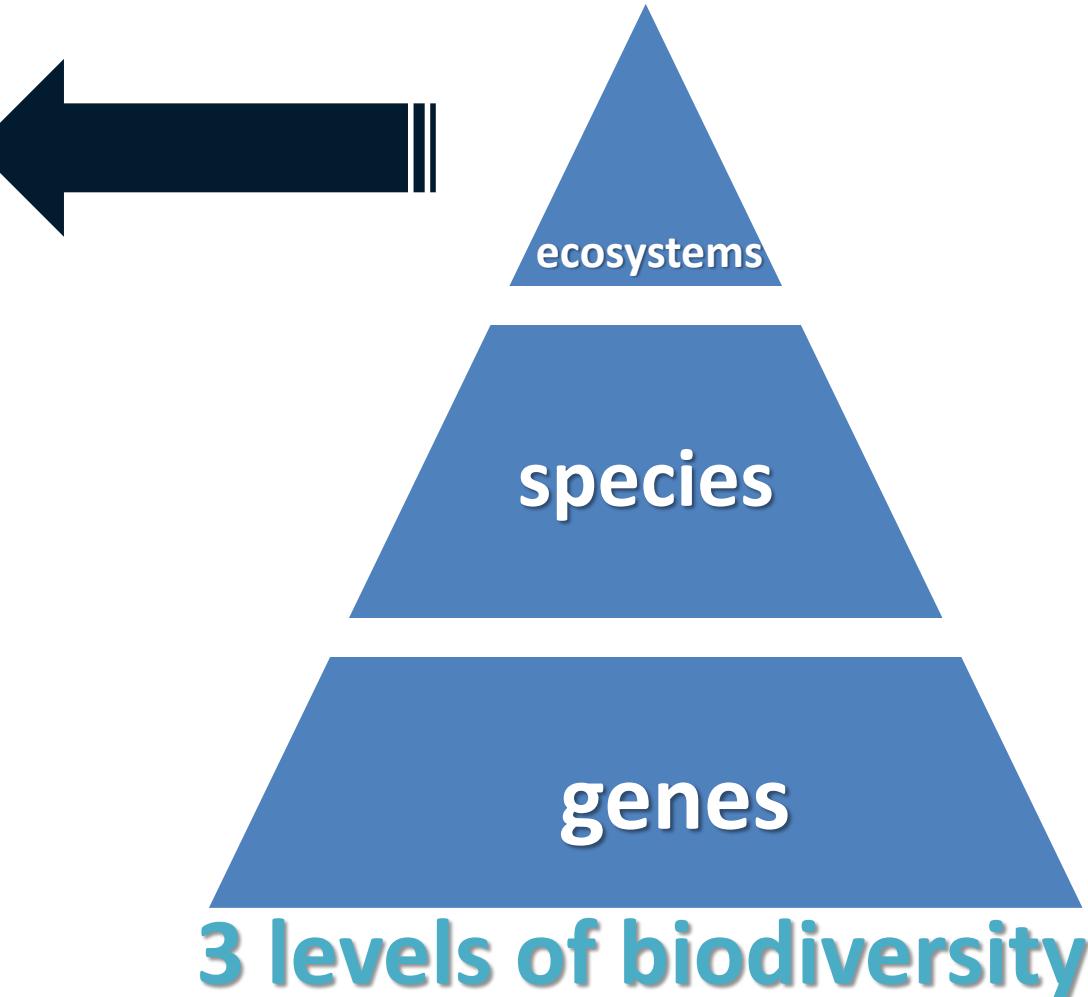


# Genes to species to landscapes (ecosystems)

3

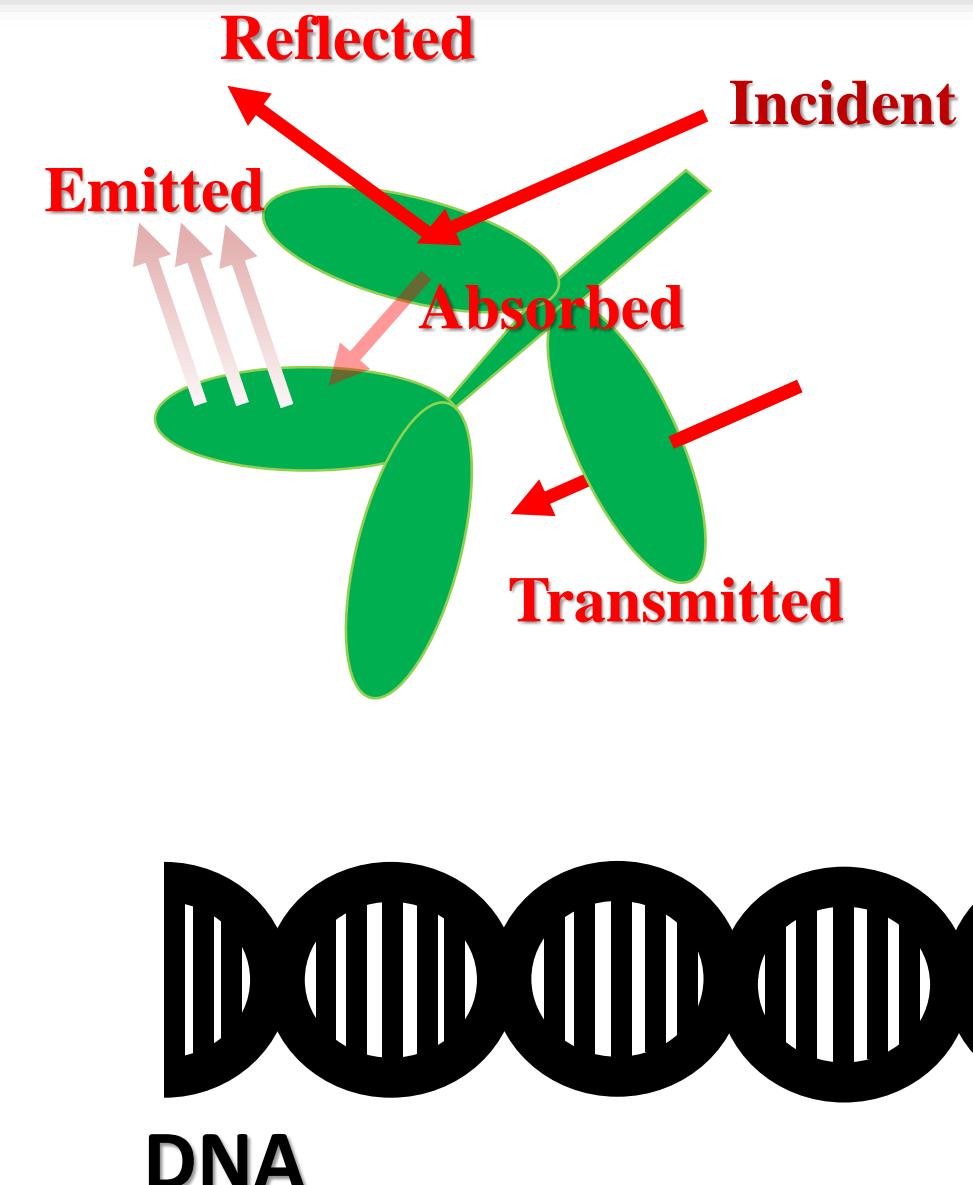
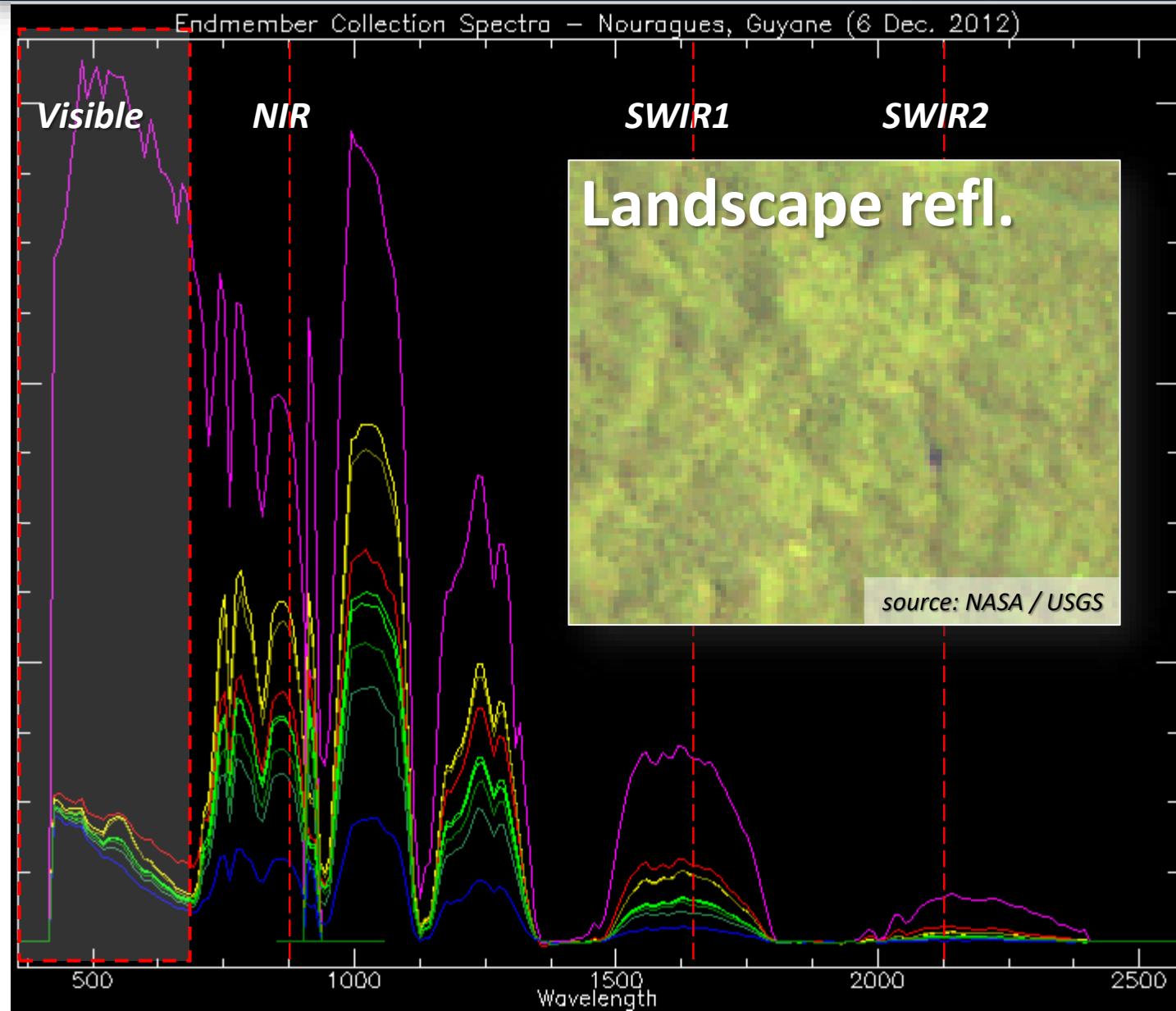


***Thematic area: Land cover,  
land use, and ecosystems***



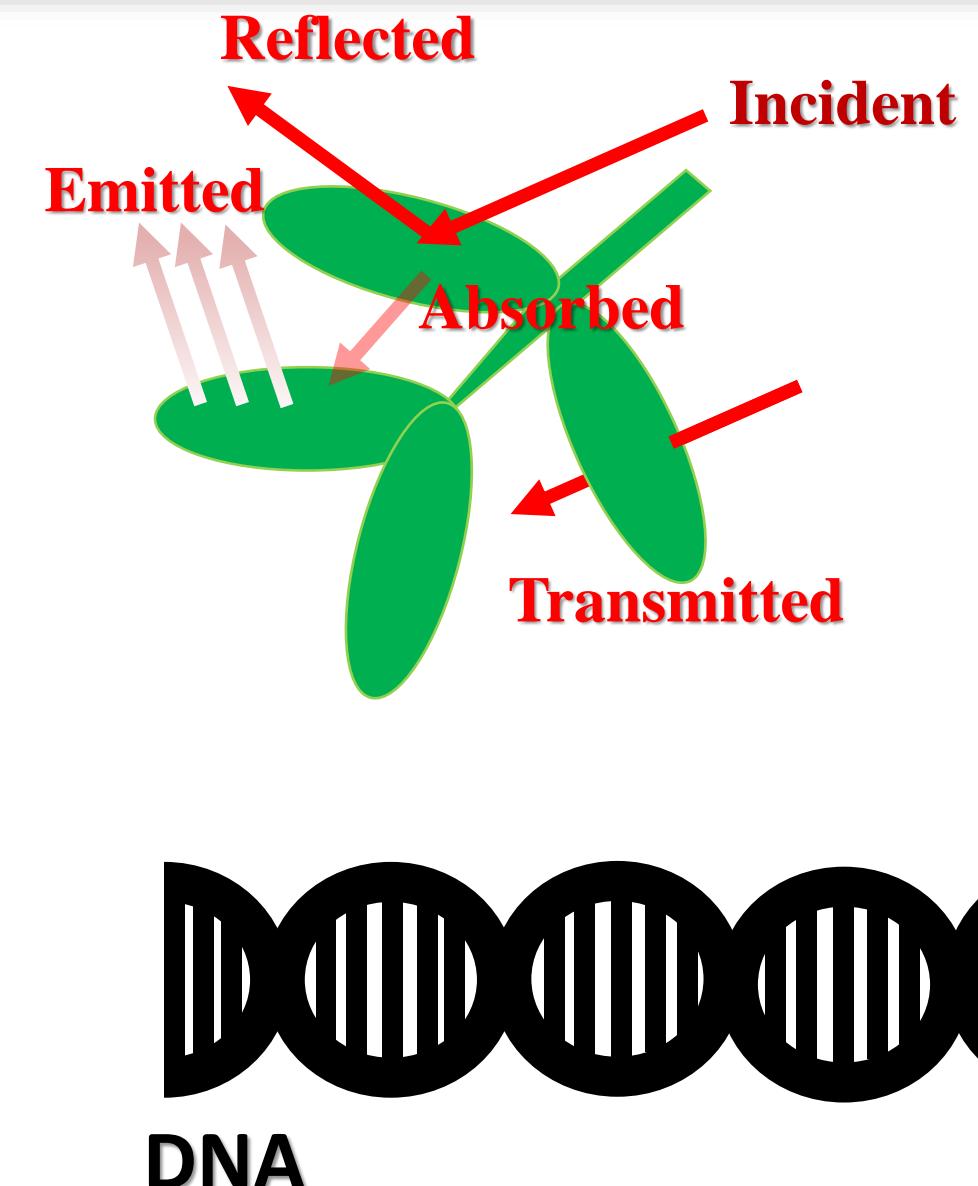
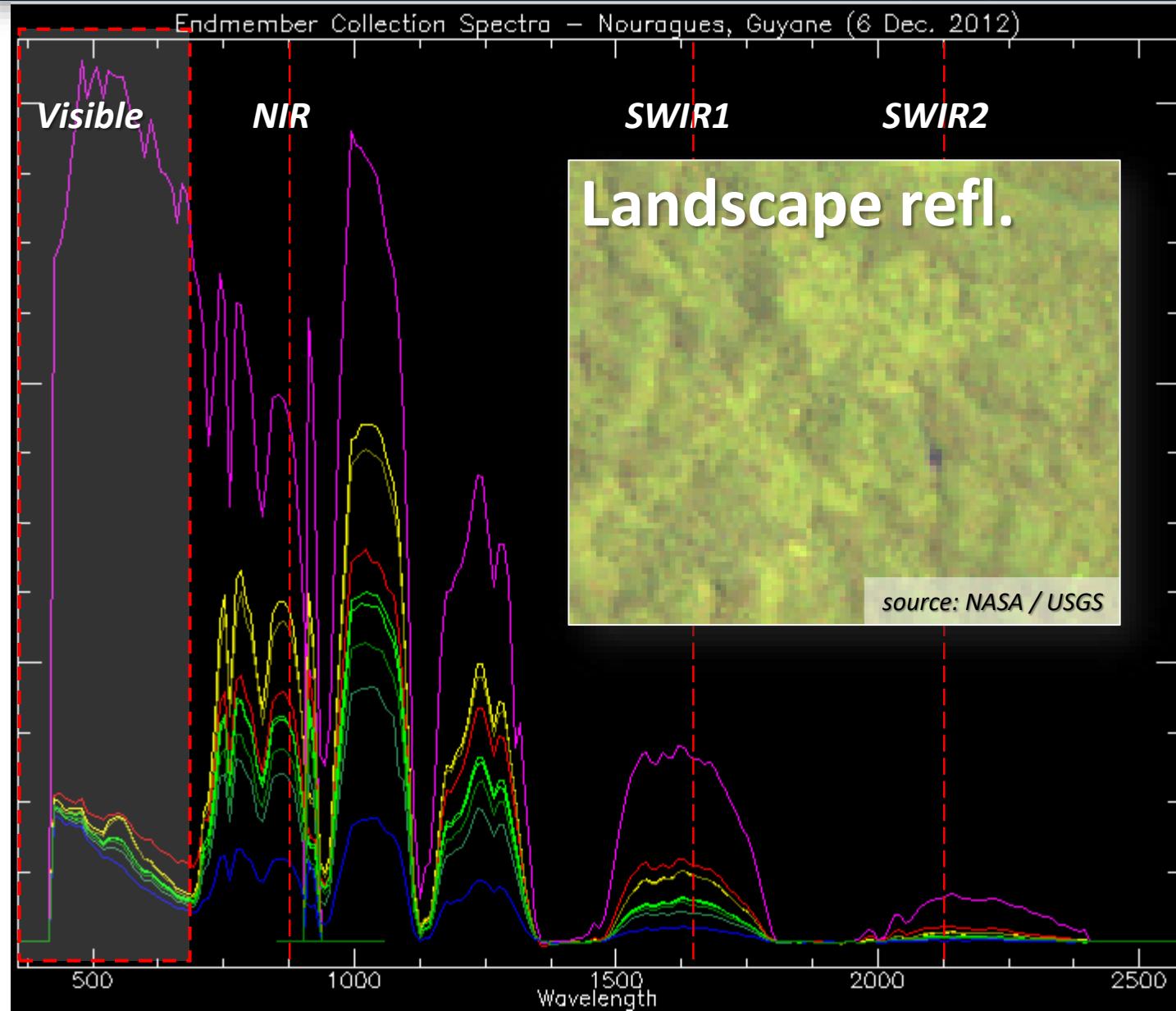
# Veg. landscapes are partly the expression of tree-level genetics

4



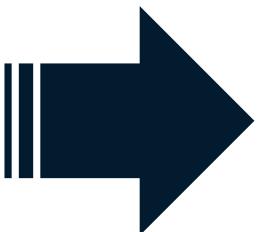
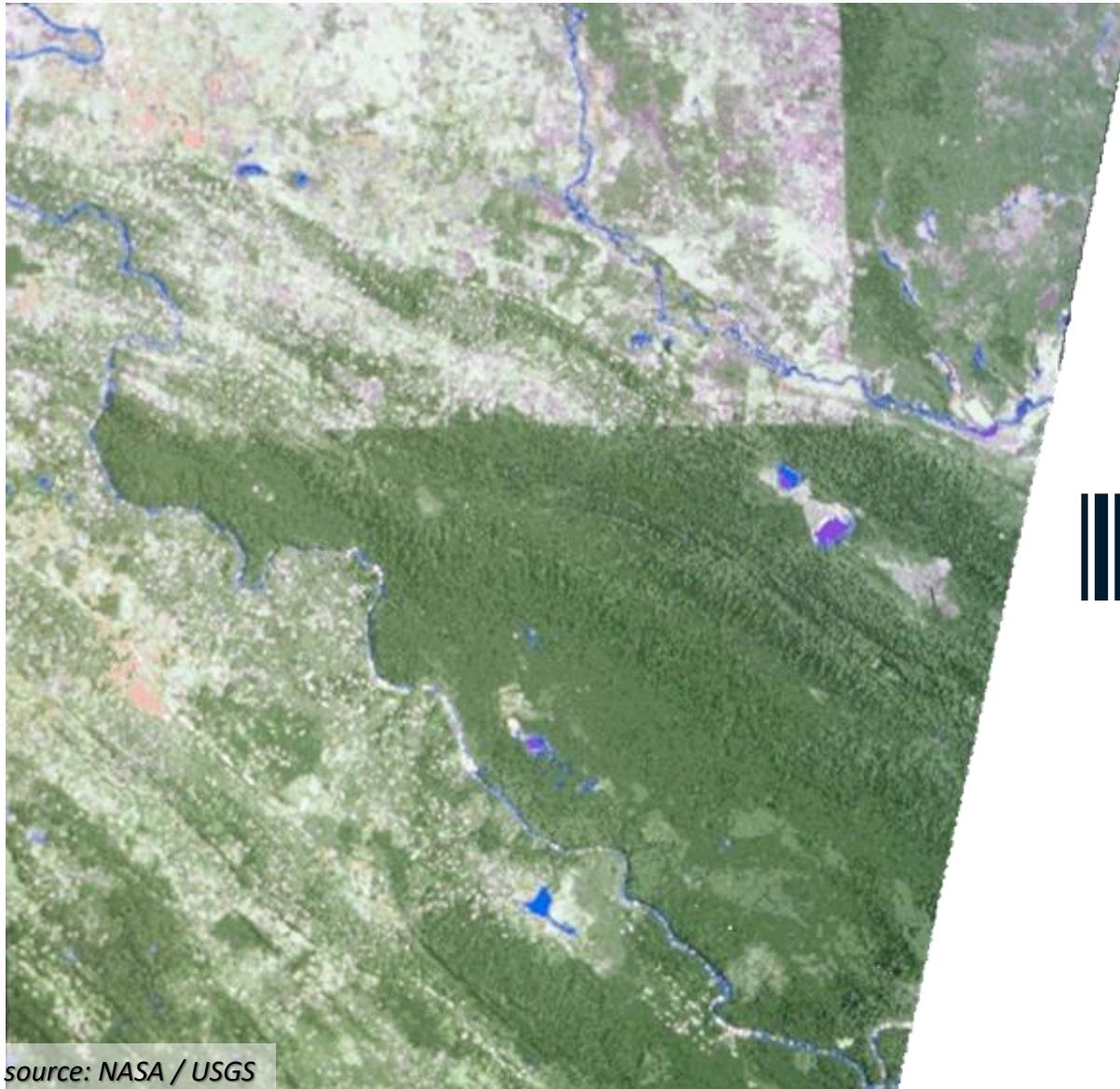
# Veg. landscapes are partly the expression of tree-level genetics

5



*A promising, 1<sup>st</sup> of its kind program...*

6



## Keeping an Eye on Central America



Inform Inspire Involve  
[science.nasa.gov](http://science.nasa.gov)



**April 23, 2004**

source: NASA / USGS

# Joining the SERVIR family

7



*SERVIR-Mesoamerica team in 2009*



**Feb. 3, 2005**

# PT 2: GLCF was only source of free Landsat data pre-SERVIR

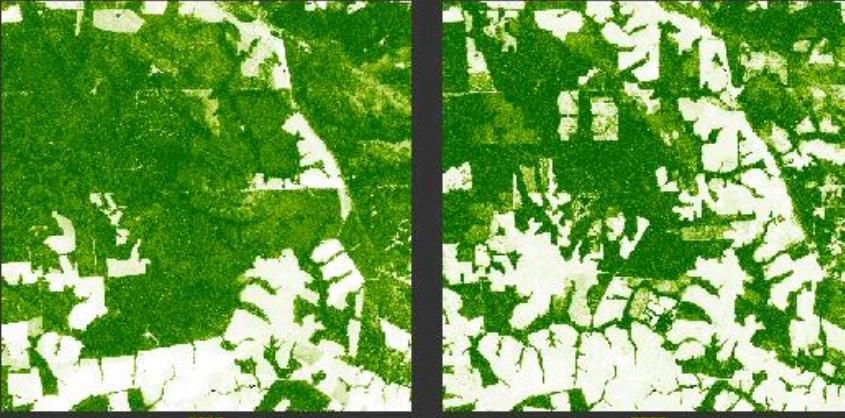
8

Global Land Cover Facility  
[www.landcover.org](http://www.landcover.org)

About GLCF Research Publications Data & Products Gallery Library Services Contact Site Map Go

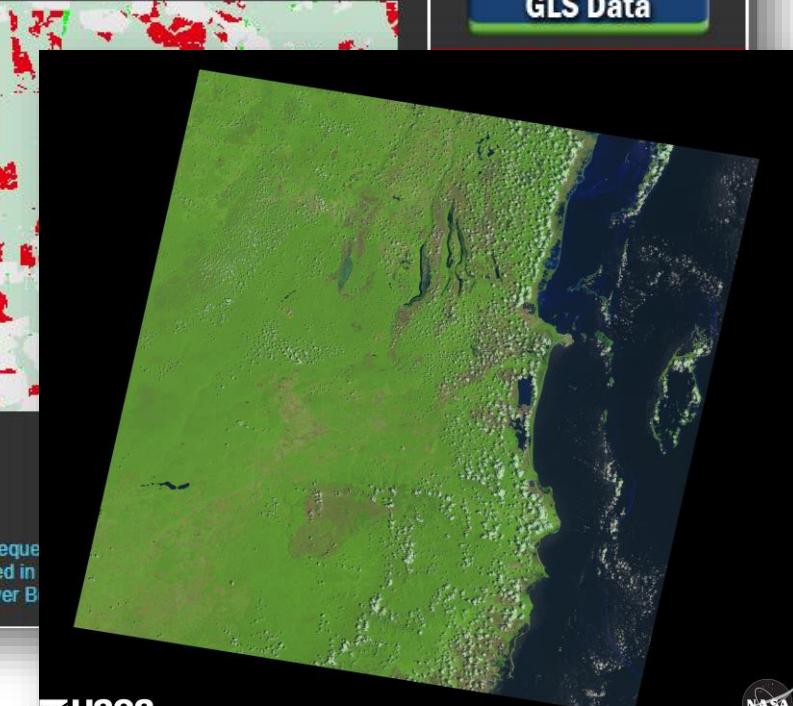
Welcome

The GLCF is a center for land cover science with a focus on research using remotely sensed satellite data and products to access land cover change for local to global systems.



2000 Path: 227 Row: 068 Brazil Landsat TreeCover Data Gallery

2005 Path: 227 Row: 068 Brazil Landsat TreeCover Data Gallery

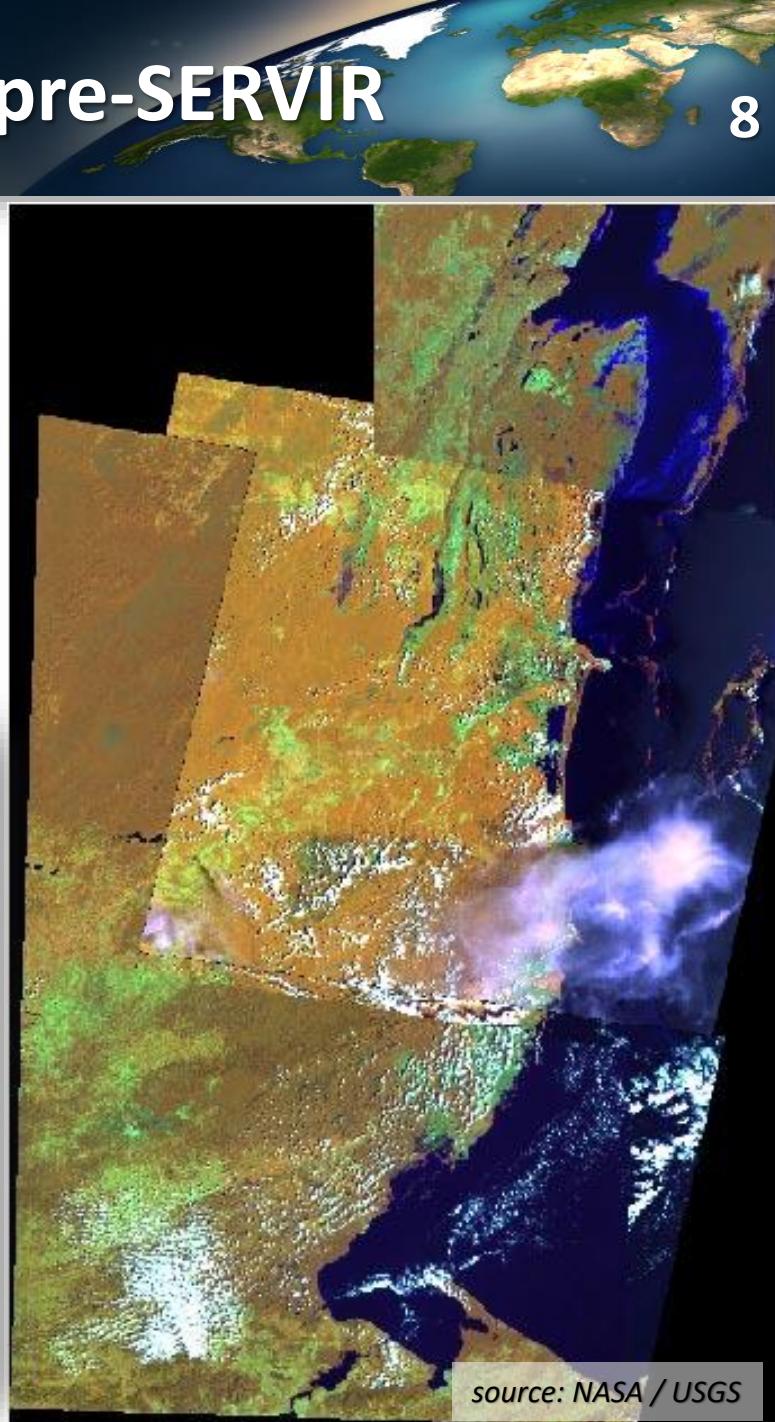


Download Data  
ESDI GLS Data

www.landcover.org

USGS NASA

source: NASA / USGS

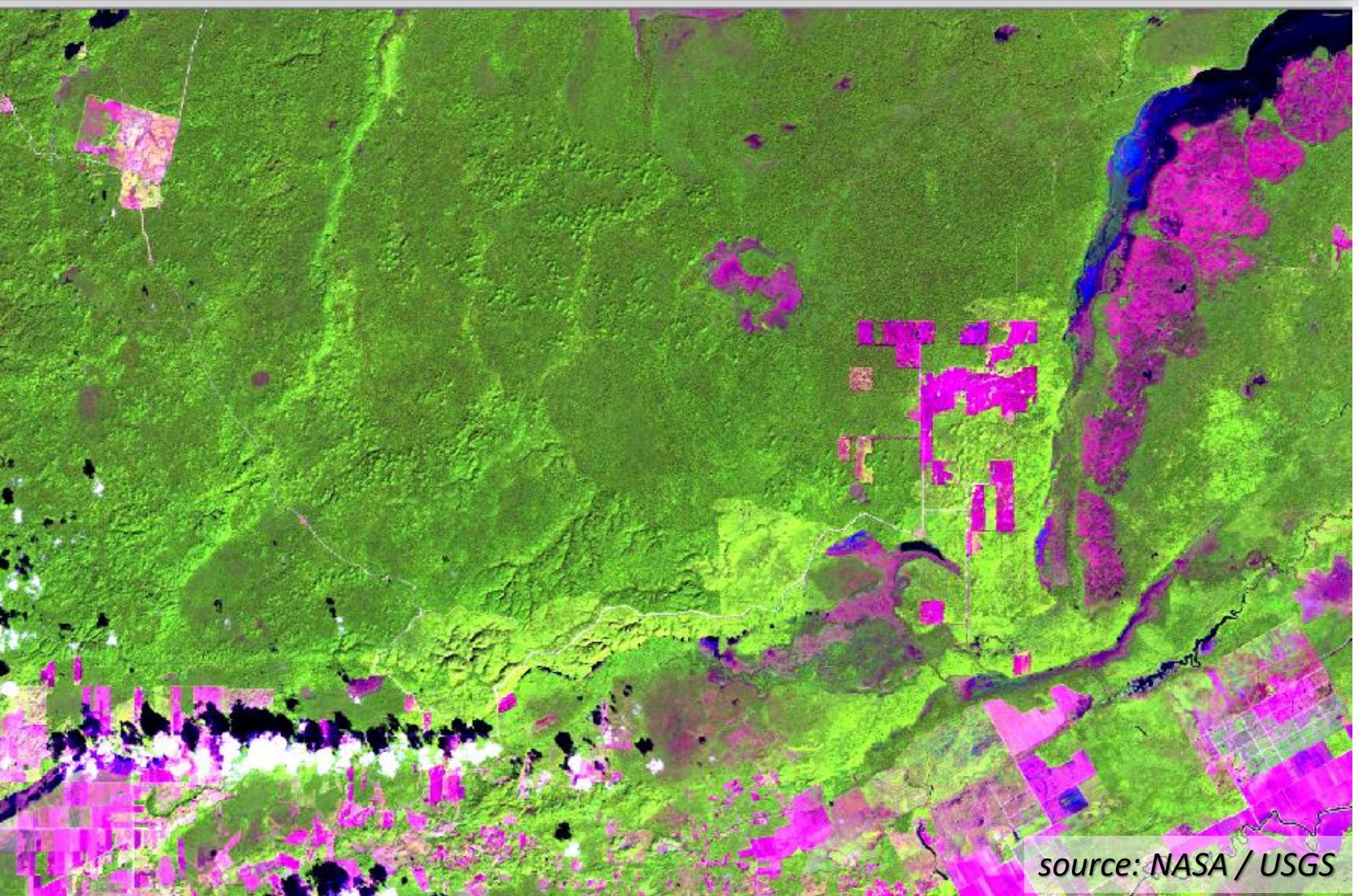


# Satellite images are beautiful, complex data puzzles

9

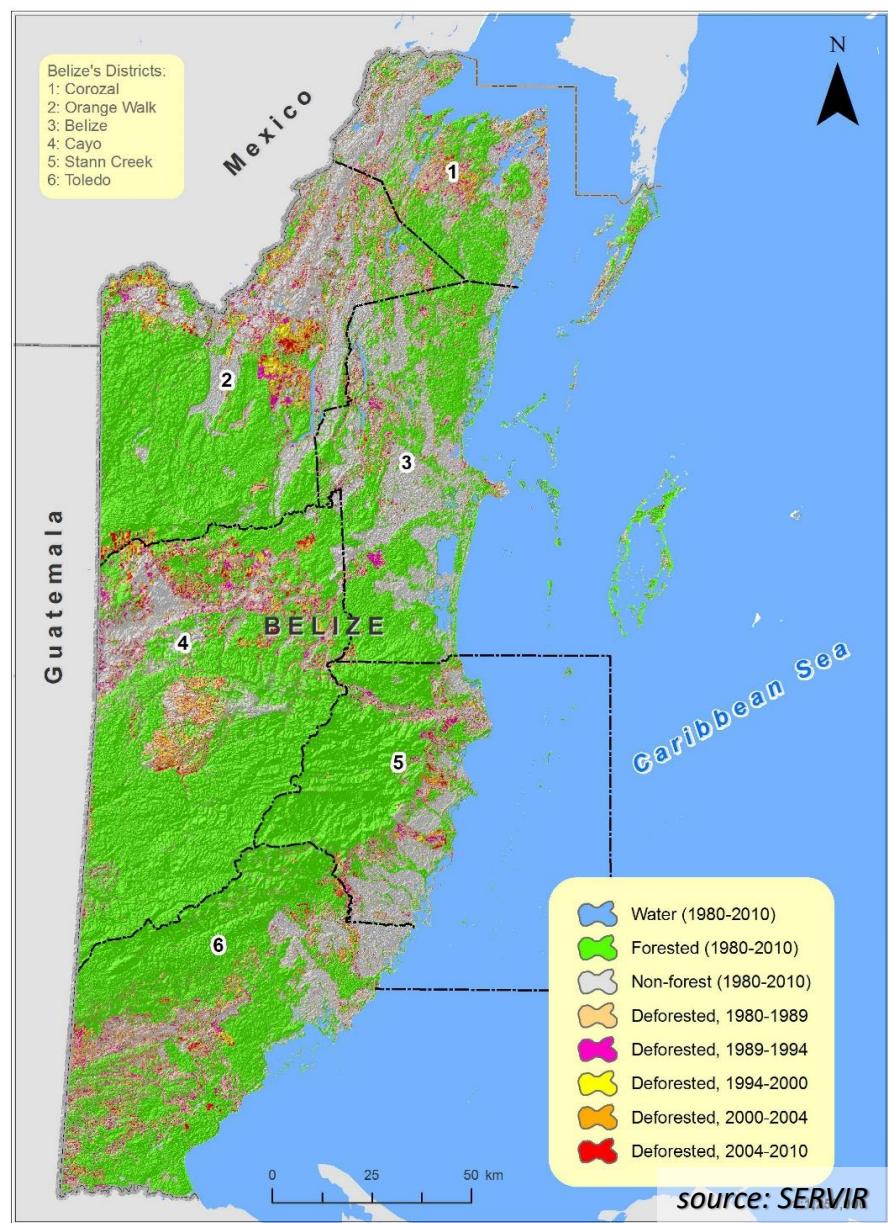


source: NASA

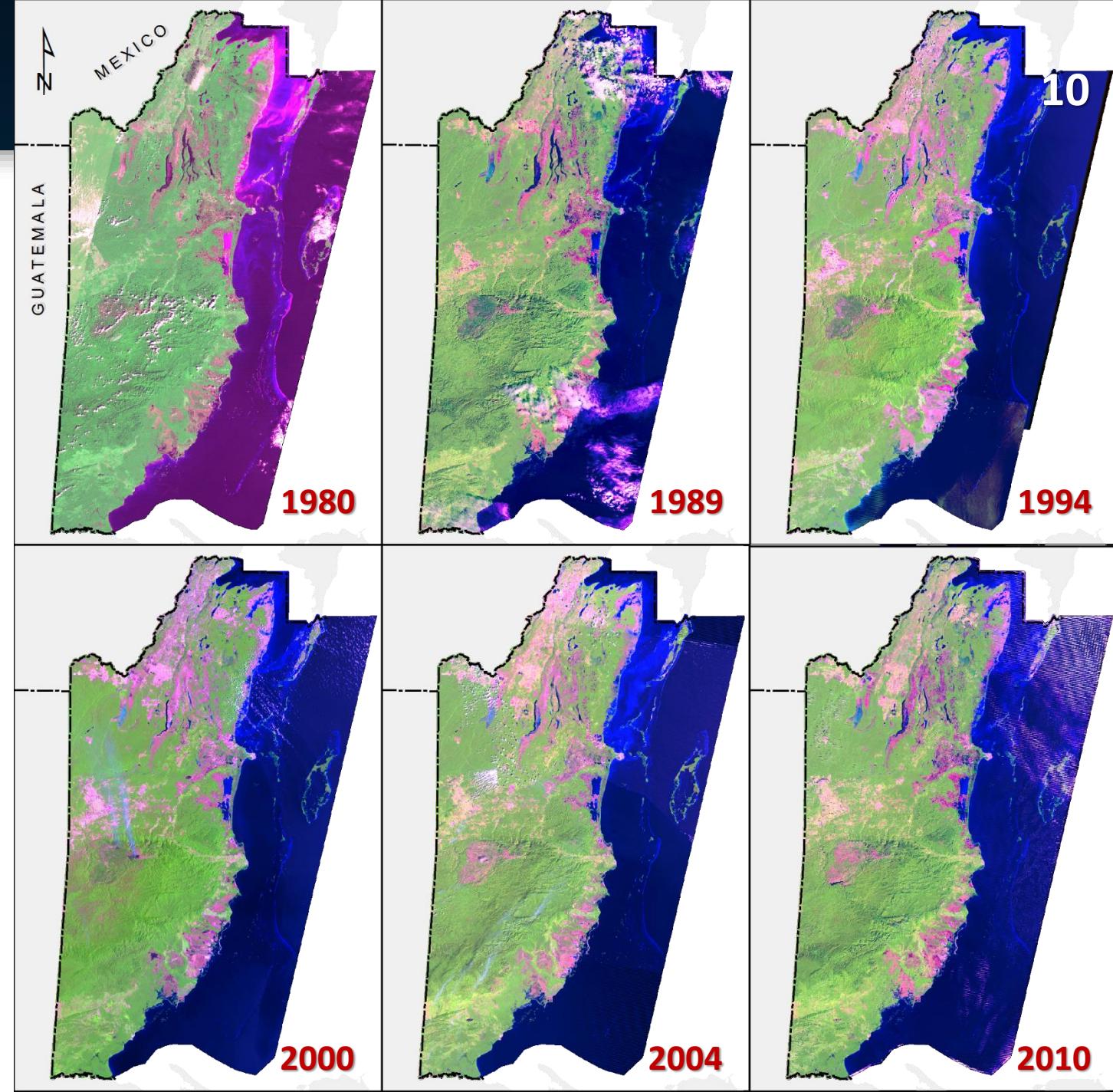


source: NASA / USGS

# From data to information

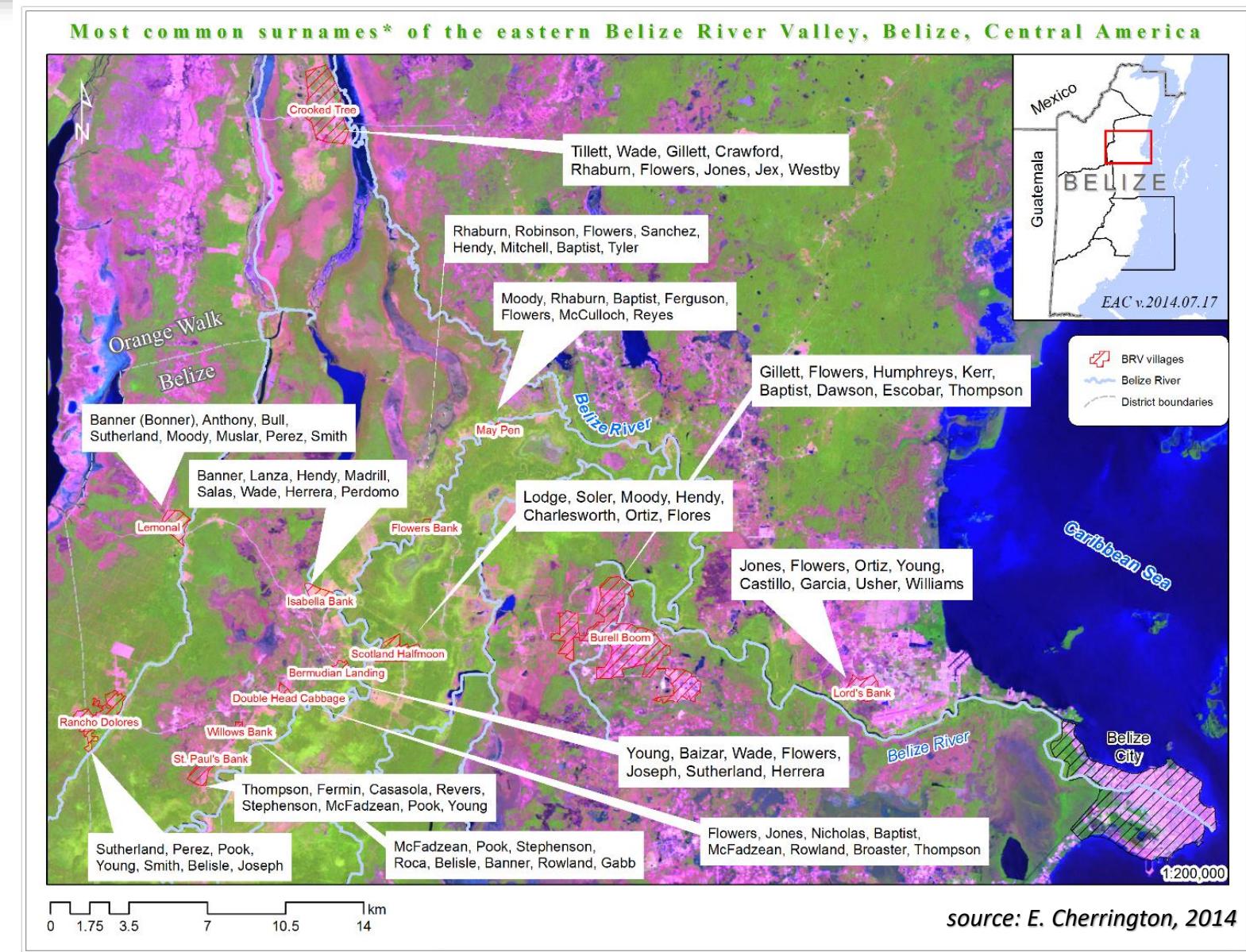
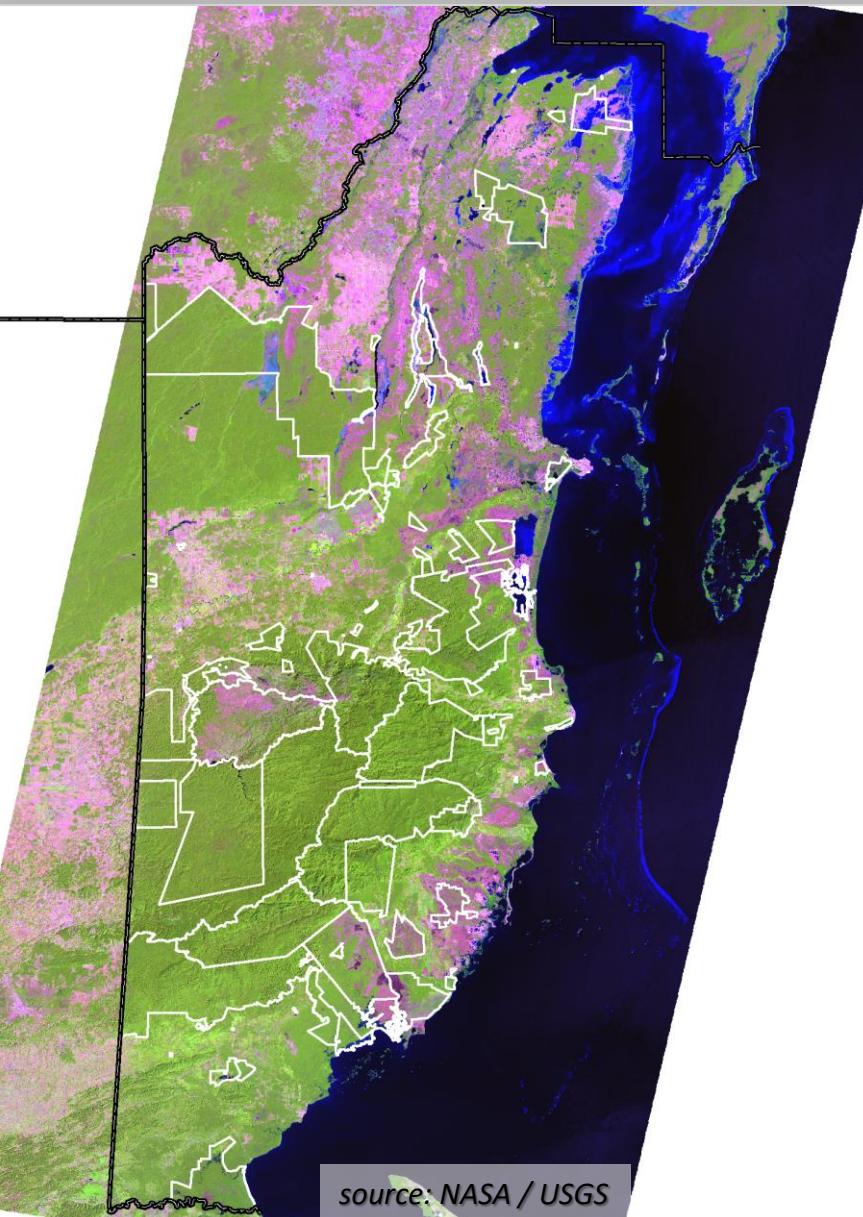


source: NASA / USGS



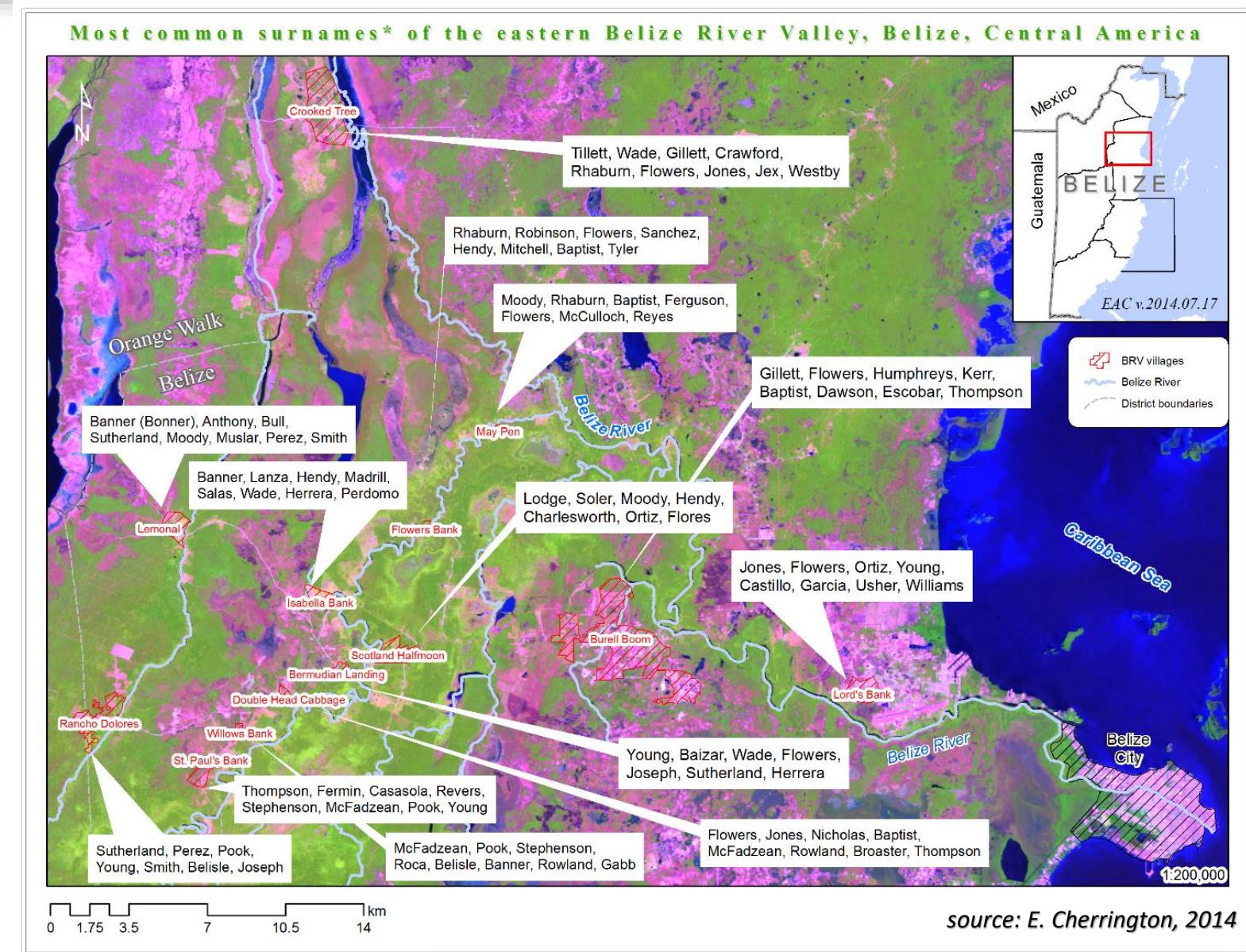
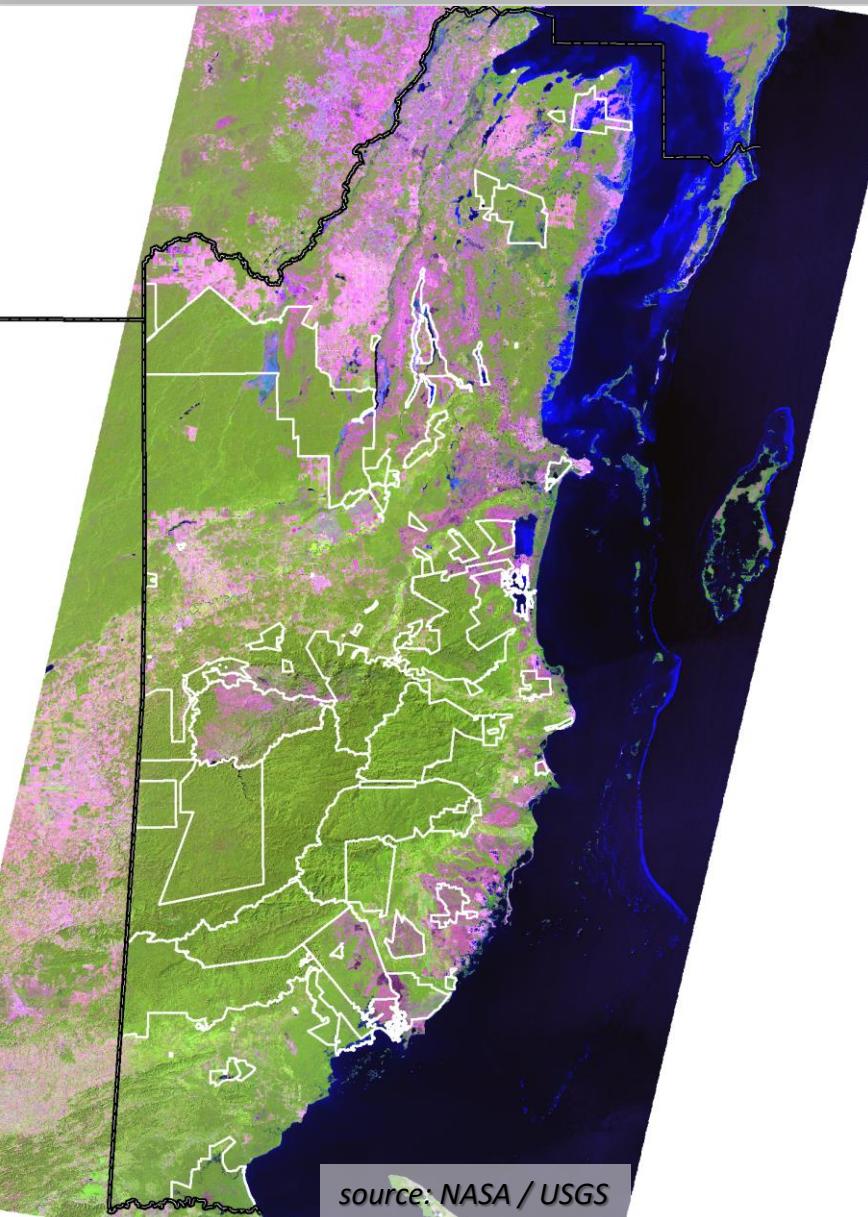
# Satellite imagery also show human influences

11



# Mosaics: Ecosystems and people

12



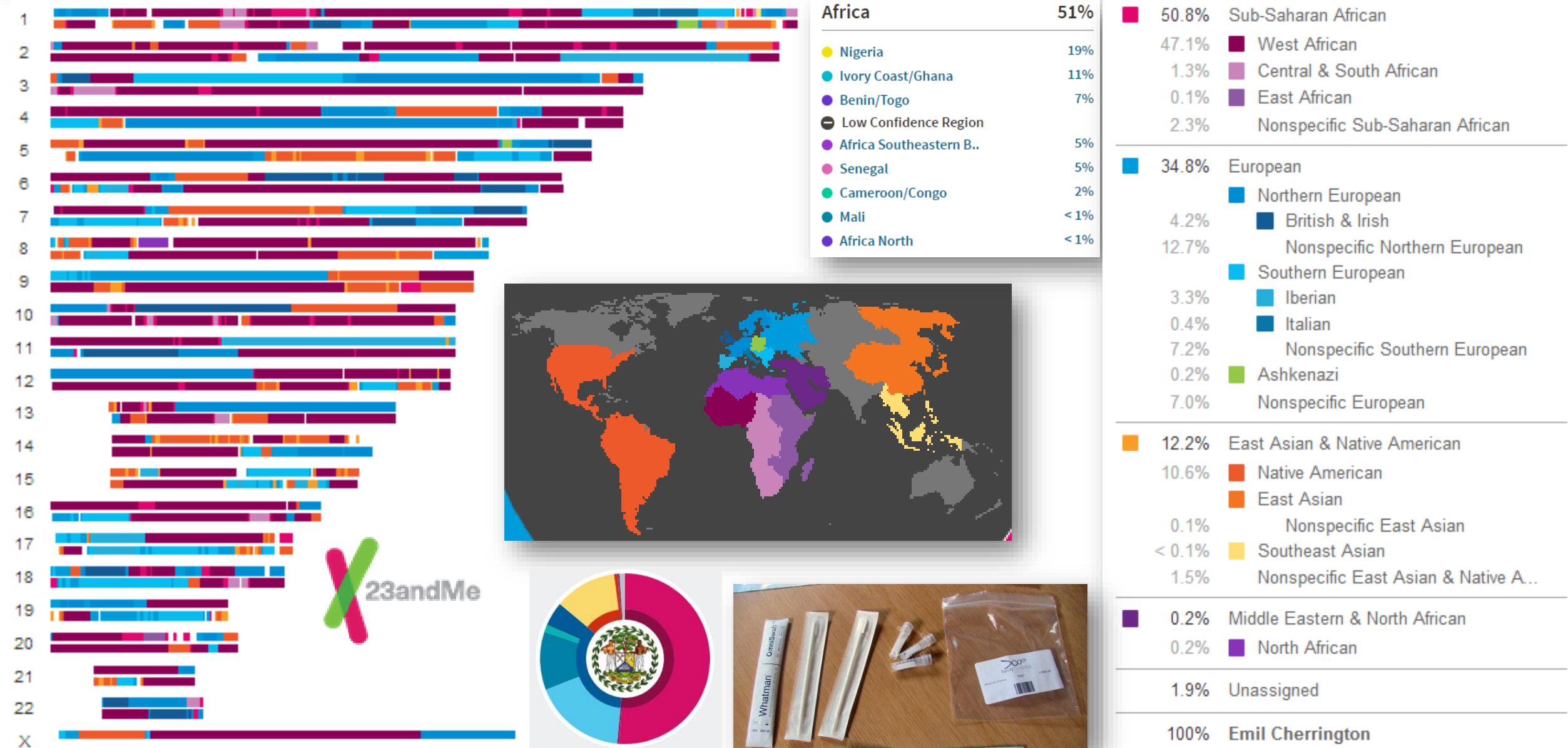
# PT 3: Chromosomes can be mapped, as well as continents

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# "A typical Belizean genetic profile"

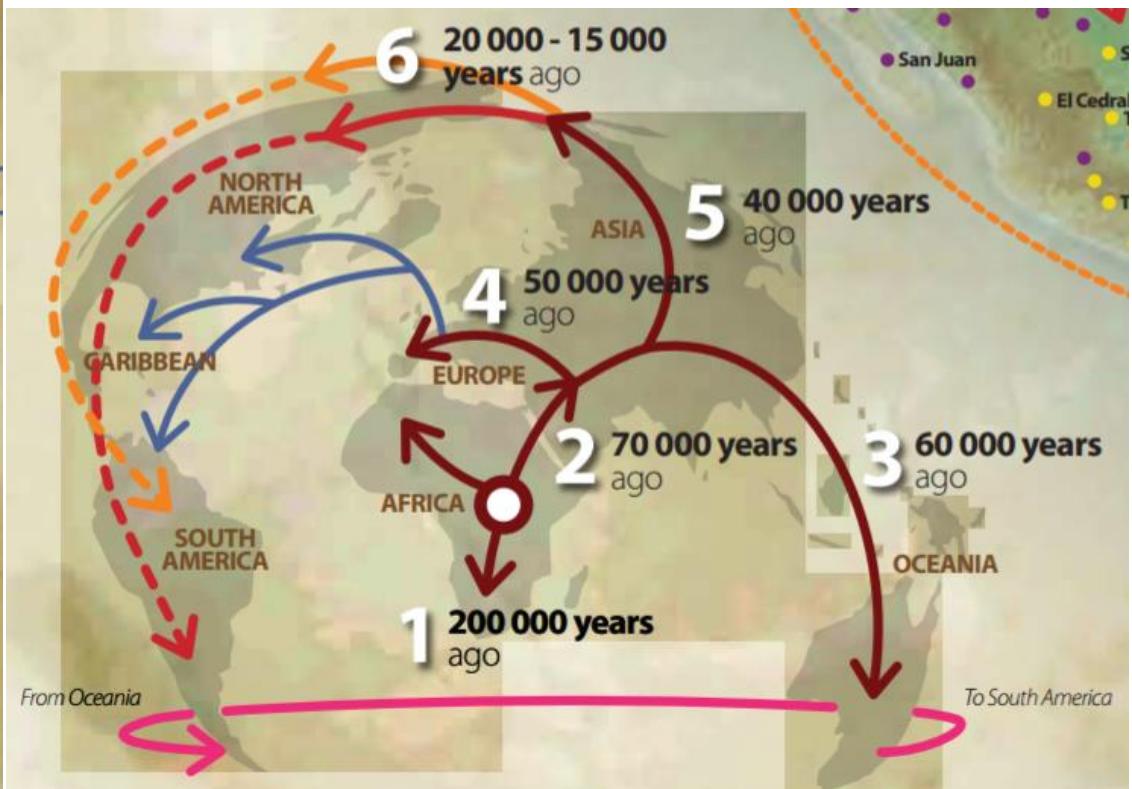
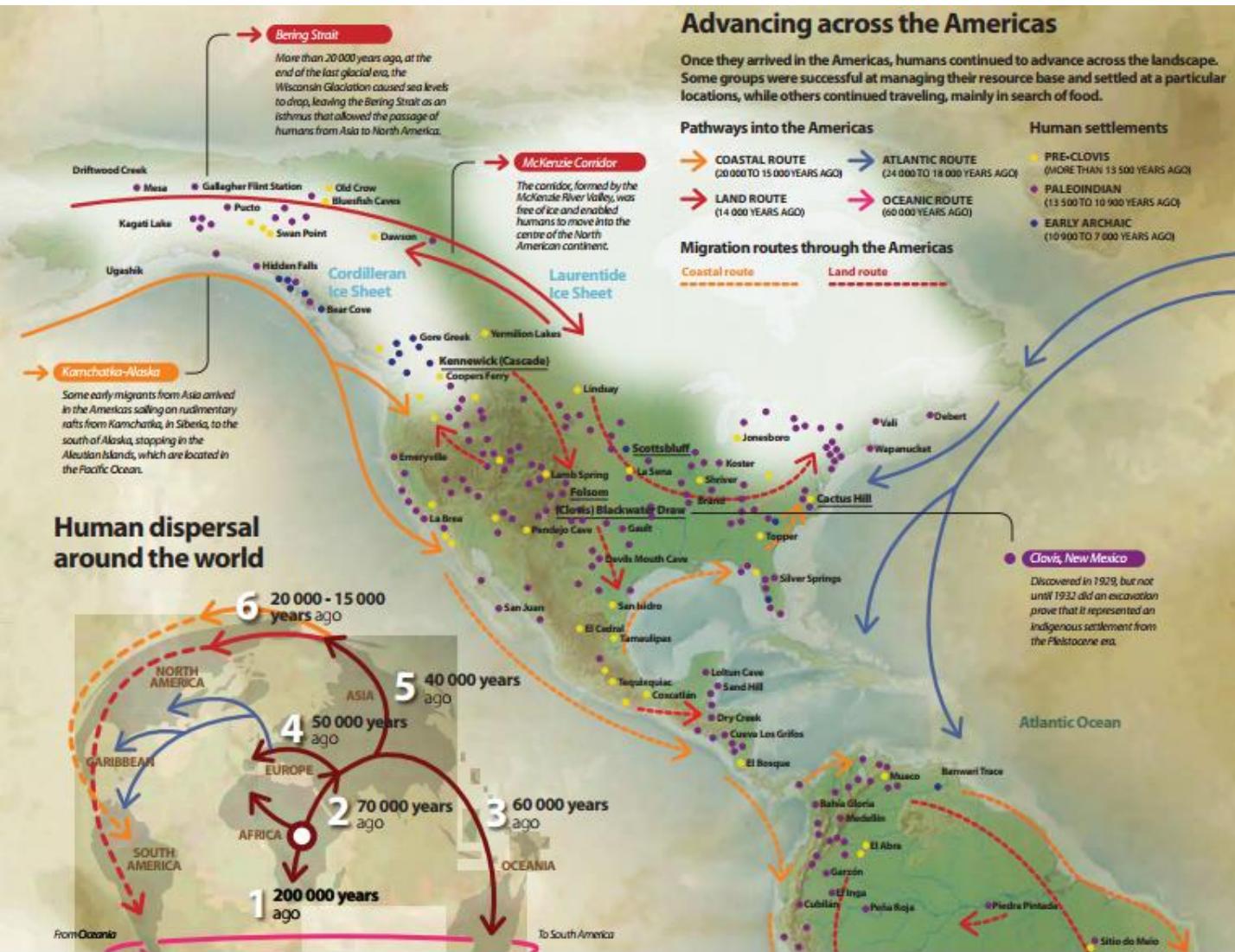
14



# Genes contain stories of human migrations

15

F999919	Clovis, Montana, 12.5ky	
F999919	Clovis, Montana, 12.5ky	
F999919	Clovis, Montana, 12.5ky	



source: UNEP / CATHALAC / USAID, 2010

# Genetic data also needs validating

*“...Remote sensing w/o validation  
is remote nonsense.”*

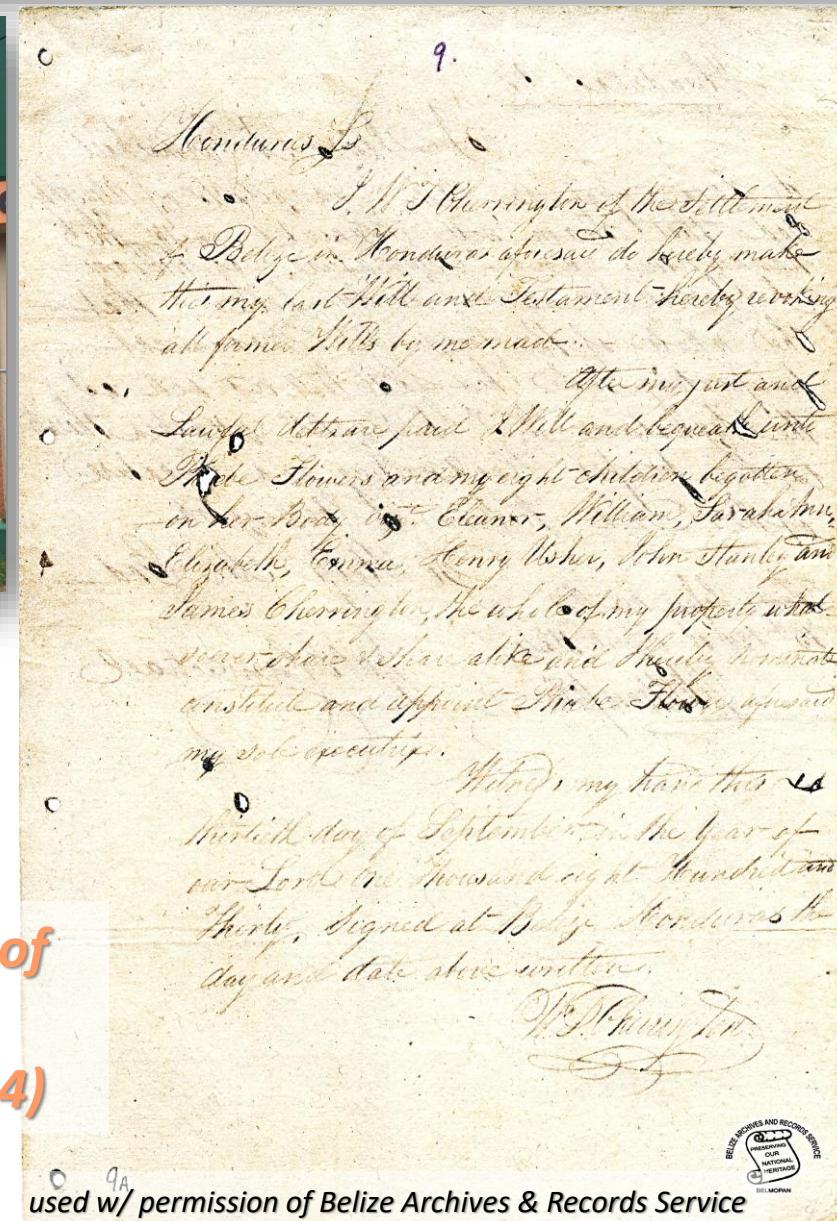
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*Big up the Belize Archives & Records Service!*



**1832 will & testament of  
Lt. Col. William Taylor  
Cherrington (1777-1834)**



used w/ permission of Belize Archives & Records Service

Gen. 1	Gen. 2 Parents	Gen. 3 Grandparents	Generation 4 1 <sup>st</sup> Great-Grandparents	Generation 5 2 <sup>nd</sup> Great-Grandparents	Generation 6 3 <sup>rd</sup> Great-Grandparents	Generation 7 4 <sup>th</sup> Great-Grandparents
			William Cherrington II <sup>[32]</sup> ? [33]	William Cherrington III <sup>[16]</sup> Josiah Cherrington <sup>[8]</sup>	William Cherrington II <sup>[32]</sup> ? [33]	William Taylor Cherrington <sup>[64]</sup> Phoebe Flowers <sup>[65]</sup> 4G GrFather <sup>[66]</sup> 4G GrMother <sup>[67]</sup> ? Maheia <sup>[68]</sup> John Maheia <sup>[34]</sup> 3G GrMother <sup>[35]</sup>
				Elizabeth Maheia <sup>[17]</sup>	John Maheia <sup>[34]</sup> 4G GrMother <sup>[69]</sup> 4G GrFather <sup>[70]</sup> 4G GrMother <sup>[71]</sup>	? Maheia <sup>[68]</sup> 4G GrFather <sup>[70]</sup> 4G GrMother <sup>[71]</sup> ? Zelaya <sup>[72]</sup> Ciriaco Zelaya Herrera <sup>[36]</sup> ? Herrera <sup>[73]</sup>
				Sabino Zelaya <sup>[18]</sup>	3G GrMother <sup>[37]</sup>	4G GrFather <sup>[74]</sup> 4G GrMother <sup>[75]</sup> ? Salvador <sup>[76]</sup> Cesario Salvador <sup>[38]</sup>
				Eusebia Josefa Zelaya <sup>[9]</sup>	3G GrMother <sup>[39]</sup>	4G GrFather <sup>[76]</sup> 4G GrMother <sup>[77]</sup> 3G GrMother <sup>[39]</sup> 3G GrFather <sup>[40]</sup>
					Janet Flowers <sup>(?)</sup> <sup>[21]</sup>	4G GrMother <sup>[81]</sup> 4G GrFather <sup>[82]</sup> 4G GrMother <sup>[83]</sup> 3G GrMother <sup>[41]</sup> 3G GrFather <sup>[42]</sup> 3G GrMother <sup>[43]</sup> 3G GrFather <sup>[44]</sup>
					James Young <sup>(?)</sup> <sup>[20]</sup>	4G GrMother <sup>[84]</sup> 4G GrFather <sup>[85]</sup> 3G GrMother <sup>[41]</sup> 3G GrFather <sup>[42]</sup> 3G GrMother <sup>[43]</sup> 3G GrFather <sup>[44]</sup> 3G GrMother <sup>[45]</sup> ? Ortega <sup>[22]</sup>
					Amelia Alberta Young <sup>[5]</sup>	4G GrFather <sup>[86]</sup> 4G GrMother <sup>[87]</sup> 4G GrFather <sup>[88]</sup> 4G GrMother <sup>[89]</sup> 3G GrMother <sup>[46]</sup> 3G GrFather <sup>[47]</sup> ? [23]
					Fernanda Ortega <sup>[11]</sup>	4G GrFather <sup>[90]</sup> 4G GrMother <sup>[91]</sup> 4G GrFather <sup>[92]</sup> 4G GrMother <sup>[93]</sup> 3G GrMother <sup>[47]</sup> 3G GrFather <sup>[48]</sup> 4G GrMother <sup>[95]</sup> 4G GrFather <sup>[96]</sup> 4G GrMother <sup>[97]</sup> ? [24]
					Ramsey G.F.C. Leacock <sup>[6]</sup>	4G GrMother <sup>[98]</sup> 4G GrFather <sup>[99]</sup> 4G GrMother <sup>[100]</sup> 4G GrFather <sup>[101]</sup> Emilie (Amelia) Helena Strack <sup>[50]</sup> Helena Gertrud Strack <sup>[51]</sup>
					Emilia E. Leacock-Cherrington <sup>[3]</sup>	Wilhelm Strack <sup>[102]</sup> Gertrud Moslech <sup>[103]</sup> Michael Strack <sup>[102]</sup> Anna Strack <sup>[103]</sup> 4G GrFather <sup>[104]</sup> 4G GrMother <sup>[105]</sup> 4G GrFather <sup>[106]</sup> 4G GrMother <sup>[107]</sup> John ? <sup>[26]</sup>
					Rita E. Encalada-Leacock <sup>[7]</sup>	4G GrFather <sup>[108]</sup> 4G GrMother <sup>[109]</sup> 4G GrFather <sup>[110]</sup> 4G GrMother <sup>[111]</sup> Mabel Peters <sup>[27]</sup>
					Alejandro Encalada <sup>[14]</sup>	4G GrFather <sup>[112]</sup> 4G GrMother <sup>[113]</sup> 4G GrFather <sup>[114]</sup> 4G GrMother <sup>[115]</sup> ? Encalada <sup>[28]</sup>
						4G GrFather <sup>[116]</sup> 4G GrMother <sup>[117]</sup> 4G GrFather <sup>[118]</sup> 4G GrMother <sup>[119]</sup> Catalina Mejia <sup>[29]</sup>
						4G GrFather <sup>[120]</sup> 4G GrMother <sup>[121]</sup> 4G GrFather <sup>[122]</sup> 4G GrMother <sup>[123]</sup> David Emmanuel Bood <sup>[30]</sup>
						4G GrFather <sup>[124]</sup> 4G GrMother <sup>[125]</sup> Cristobel Vaccaro <sup>[31]</sup>
						4G GrFather <sup>[126]</sup> 4G GrMother <sup>[127]</sup> Catherine ?-Vaccaro <sup>[63]</sup>

# Like understanding reflectance, family history is its own puzzle

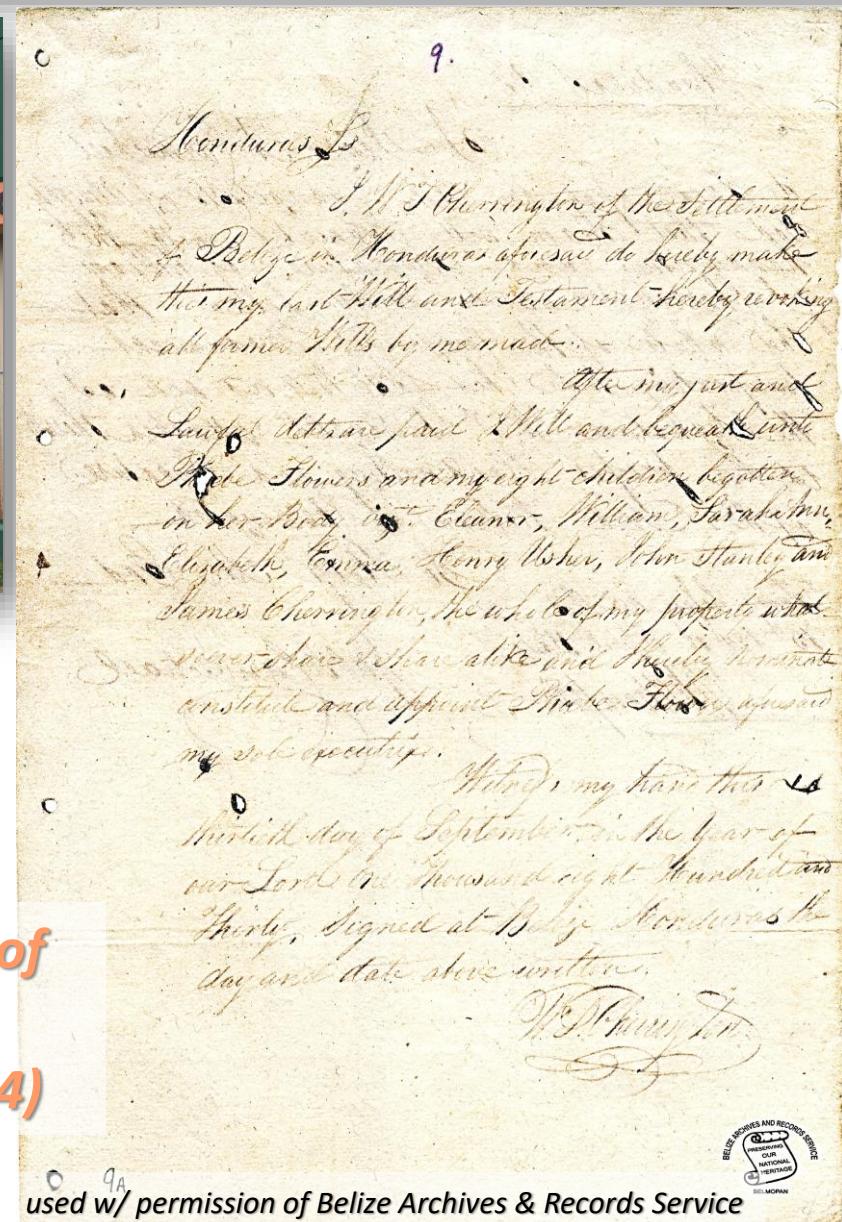
17



*Big up the Belize Archives & Records Service!*

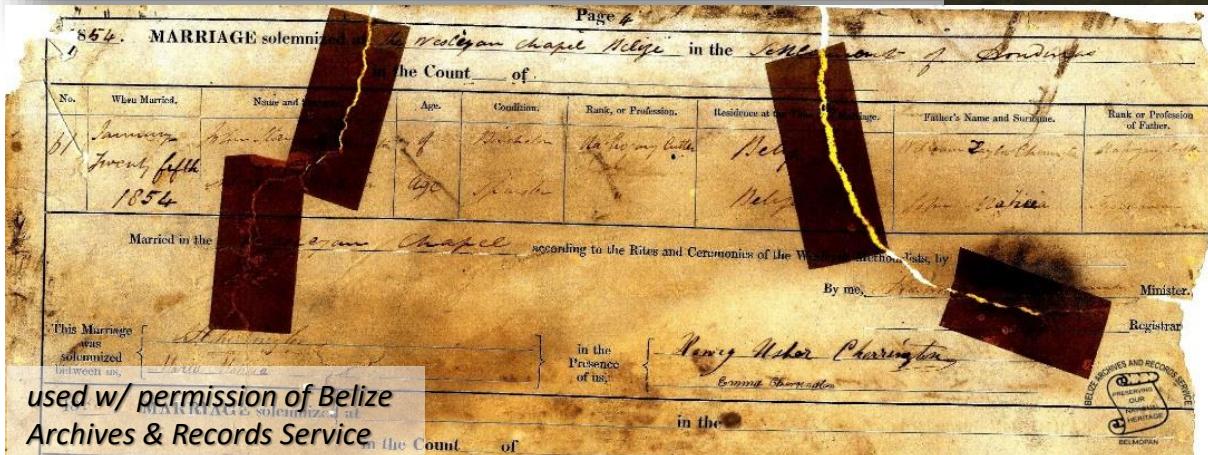


**1832 will & testament of  
Lt. Col. William Taylor  
Cherrington (1777-1834)**



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		Herman Alexander Cherrington <sup>[1]</sup>	Josiah Cherrington <sup>[8]</sup>	Sabino Zelaya <sup>[18]</sup>	Cyriaco Zelaya Herrera <sup>[36]</sup> 3G GrMother <sup>[37]</sup>	Eusebia Josefa Zelaya <sup>[9]</sup> Cesario Salvador <sup>[28]</sup> Delfina Salvador <sup>[19]</sup>
		James Young <sup>[10]</sup>	William Young (?) <sup>[20]</sup>	James Young <sup>[10]</sup>	3G GrFather <sup>[40]</sup> 3G GrMother <sup>[41]</sup>	3G GrFather <sup>[40]</sup> 4G GrMother <sup>[81]</sup> 4G GrFather <sup>[82]</sup> 4G GrMother <sup>[83]</sup> 4G GrFather <sup>[84]</sup> Janet Flowers <sup>(?)<sup>[21]</sup></sup>
		Amyline Alberta Young <sup>[5]</sup>	? Ortega <sup>[22]</sup>	Fernanda Ortega <sup>[11]</sup>	3G GrFather <sup>[44]</sup> 3G GrMother <sup>[45]</sup> 3G GrFather <sup>[46]</sup> ? [23]	3G GrFather <sup>[44]</sup> 4G GrMother <sup>[85]</sup> 4G GrFather <sup>[86]</sup> 4G GrMother <sup>[87]</sup> 4G GrFather <sup>[88]</sup> 4G GrMother <sup>[89]</sup> 4G GrFather <sup>[90]</sup> 4G GrMother <sup>[91]</sup> 4G GrFather <sup>[92]</sup> 4G GrMother <sup>[93]</sup> 4G GrFather <sup>[94]</sup> 4G GrMother <sup>[95]</sup> 4G GrFather <sup>[96]</sup> 4G GrMother <sup>[97]</sup> 4G GrFather <sup>[98]</sup> 4G GrMother <sup>[99]</sup>
		Ramsay G.F.C. Leacock <sup>[6]</sup>	Karl Stanislaus Heusner <sup>[12]</sup>	Jacob Heusner <sup>[24]</sup>	Emilie (Amelia) Helena Strack-Heusner <sup>[25]</sup> Helena Gertrud Strack <sup>[51]</sup>	Emilie (Amelia) Helena Strack-Heusner <sup>[25]</sup> Helena Gertrud Strack <sup>[51]</sup> Carl Wilhelm August Strack <sup>[50]</sup> Wilhelm Strack <sup>[100]</sup> Gertrud Moslech <sup>[101]</sup> Michael Strack <sup>[102]</sup> Anna Strack <sup>[103]</sup>
		Avis Viola Peters-Leacock <sup>[13]</sup>	John ? <sup>[26]</sup>	John ? <sup>[26]</sup>	Mabel Peters <sup>[27]</sup>	John ? <sup>[26]</sup> ? [52] ? [53]
		Rita E. Encalada-Leacock <sup>[7]</sup>	Alejandro Encalada <sup>[14]</sup>	? Encalada <sup>[28]</sup>	Catalina Mejia <sup>[29]</sup>	Frederick Peters <sup>[54]</sup> Carmen Loriano Flores <sup>[55]</sup>
				? Mejia <sup>[58]</sup>	? Mejia <sup>[58]</sup> ? [59]	? Encalada <sup>[56]</sup> 4G GrMother <sup>[111]</sup> 4G GrFather <sup>[114]</sup> 4G GrMother <sup>[115]</sup> 4G GrFather <sup>[116]</sup> 4G GrMother <sup>[117]</sup> 4G GrFather <sup>[118]</sup> 4G GrMother <sup>[119]</sup> 4G GrFather <sup>[120]</sup> 4G GrMother <sup>[121]</sup> 4G GrFather <sup>[122]</sup> 4G GrMother <sup>[123]</sup> 4G GrMother <sup>[124]</sup> 4G GrMother <sup>[125]</sup> 4G GrFather <sup>[126]</sup> 4G GrMother <sup>[127]</sup>
				David Emmanuel Bood <sup>[30]</sup>	David Emmanuel Bood <sup>[30]</sup> ? Cabral <sup>[61]</sup>	David Emmanuel Bood <sup>[30]</sup> ? Cabral <sup>[61]</sup> ? Vaccaro <sup>[62]</sup> Cristobel Vaccaro <sup>[31]</sup>
				Aileen Bood <sup>[15]</sup>	Catherine ?-Vaccaro <sup>[63]</sup>	Catherine ?-Vaccaro <sup>[63]</sup> ? Vaccaro <sup>[62]</sup> 4G GrFather <sup>[124]</sup> 4G GrMother <sup>[125]</sup> 4G GrFather <sup>[126]</sup> 4G GrMother <sup>[127]</sup>

# Landscapes speak to us





854. MARRIAGE solemnized at the Wesleyan Chapel Belize in the Settlement of Sonoma in the County of Belize

Page 6

No.	When Married,	Name and Surname of Groom	Age,	Condition,	Rank, or Profession,	Residence at Time of Marriage.	Father's Name and Surname.	Rank or Profession of Father.
61	January twenty fifth 1854	Brown	26	Bachelor	Labourer	Belize	John Taylor Brown	Belize

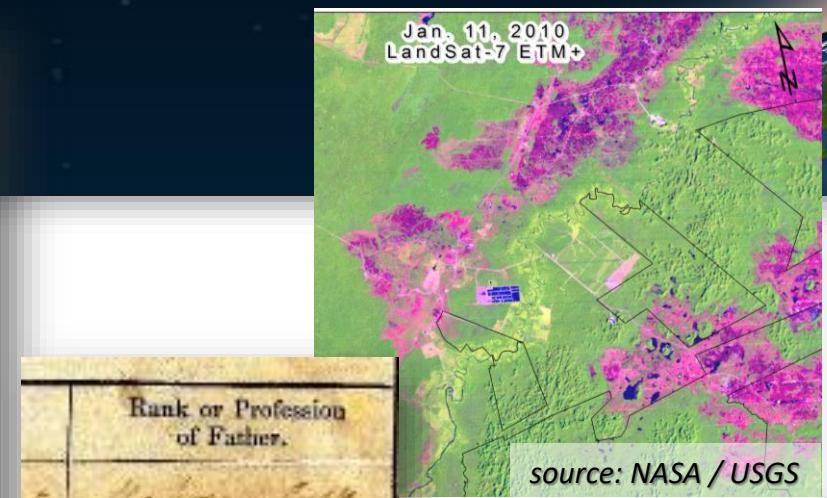
Married in the  
Baptist Chapel according to the Rites and Ceremonies of the Wesleyan Methodists, by  
By me,  
Minister.

This Marriage was solemnized between us,  
in the Presence of us:  
Davy Alexander Cherrington  
Emma Cherrington

used w/ permission of Belize Archives & Records Service

in the Count. of

BELIZE ARCHIVES AND RECORDS SERVICE  
AGRICULTURE, FORESTRY, AND HERITAGE  
GOVERNMENT OF BELIZE



The University of Washington  
The Regents of the University on recommendation of  
the University Faculty and by virtue of the Authority  
vested in them by law have conferred upon

Emil Alexander Cherrington

the degree of

Master of Science

and have granted all the Rights, Privileges and Honors thereto pertaining  
Given at Seattle, in the State of Washington, this eleventh Day of June,  
Two Thousand and Four, in the One Hundred and forty-fourth Year of the  
University.



TECHNISCHE  
UNIVERSITÄT  
DRESDEN

Graduation

President of the Board of Regents



President of the University  
Elisabeth K. Furrer  
Acting Dean, Graduate School

The Faculty of Environmental Sciences

The Faculty hereby confers upon

Mr

Emil Alexander Cherrington, MSc.

born in Belize City, Belize, on 10 December 1980

the academic degree

Doctor rerum silvaticarum  
(Dr. rer. silv.)

after the candidate proved his scientific competence in a joint German-French  
PhD programme in collaboration with AgroParisTech (Erasmus-Mundus-  
Programm FONASO - Forest and Nature for Society) based upon

Towards ecologically consistent remote sensing mapping of tree communities  
in French Guiana:  
Are forest types identifiable from spatio-temporal canopy reflectance patterns?

He earned the final grade  
magna cum laude (very good).

Dresden, 14 December 2016

The Rector

The Dean

(embossed seal)

L. Schleicher

Prof. Dr.-Ing. habil. DEng/Auckland  
Dr. h.c./Brno, Dr. h.c./Dankook  
Hans Müller-Steinhagen

(embossed seal)

L. K. Furrer

Prof. Dr. rer. nat.  
Karl-Heinz Feger

# Conclusion: This is also *your* story!

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SERVIR-Himalaya  
ICIMOD



SERVIR-Science Coordination Office,  
Applied Sciences Team,  
SERVIR Support Team



SERVIR-Eastern &  
Southern Africa  
RCMRD



SERVIR-West Africa  
AGHRYMET,  
ACMAD, AFRIGIST,  
CERSGIS, CSE, and ICRISAT



SERVIR-Mekong  
ADPC  
SIG, SEI and Deltas

Gen	# Ancestors	Year	Description
1	2	1955	Parents
2	4	1930	Grandparents
3	8	1900	1g grandparents
4	16	1870	2g grandparents
5	32	1840	3g grandparents
6	64	1810	4g grandparents
7	128	1780	5g grandparents
8	256	1750	6g grandparents
9	512	1720	7g grandparents
10	1,024	1690	8g grandparents
11	2,048	1660	9g grandparents
12	4,096	1630	10g grandparents
13	8,192	1600	11g grandparents
14	16,384	1570	12g grandparents
15	32,768	1540	13g grandparents
16	65,536	1510	14g grandparents
17	131,072	1480	15g grandparents
18	262,144	1450	16g grandparents
19	524,288	1420	17g grandparents
20	1,048,576	1390	18g grandparents
21	2,097,152	1360	19g grandparents
22	4,194,304	1330	20g grandparents
23	8,388,608	1300	21g grandparents
24	16,777,216	1270	22g grandparents
25	33,554,432	1240	23g grandparents
26	67,108,864	1210	24g grandparents
27	134,217,728	1180	25g grandparents
28	268,435,456	1150	26g grandparents
29	536,870,912	1120	27g grandparents
30	1,073,741,824	1090	28g grandparents